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Title: Dose Assessment Modeling at Los Alamos National Lab.

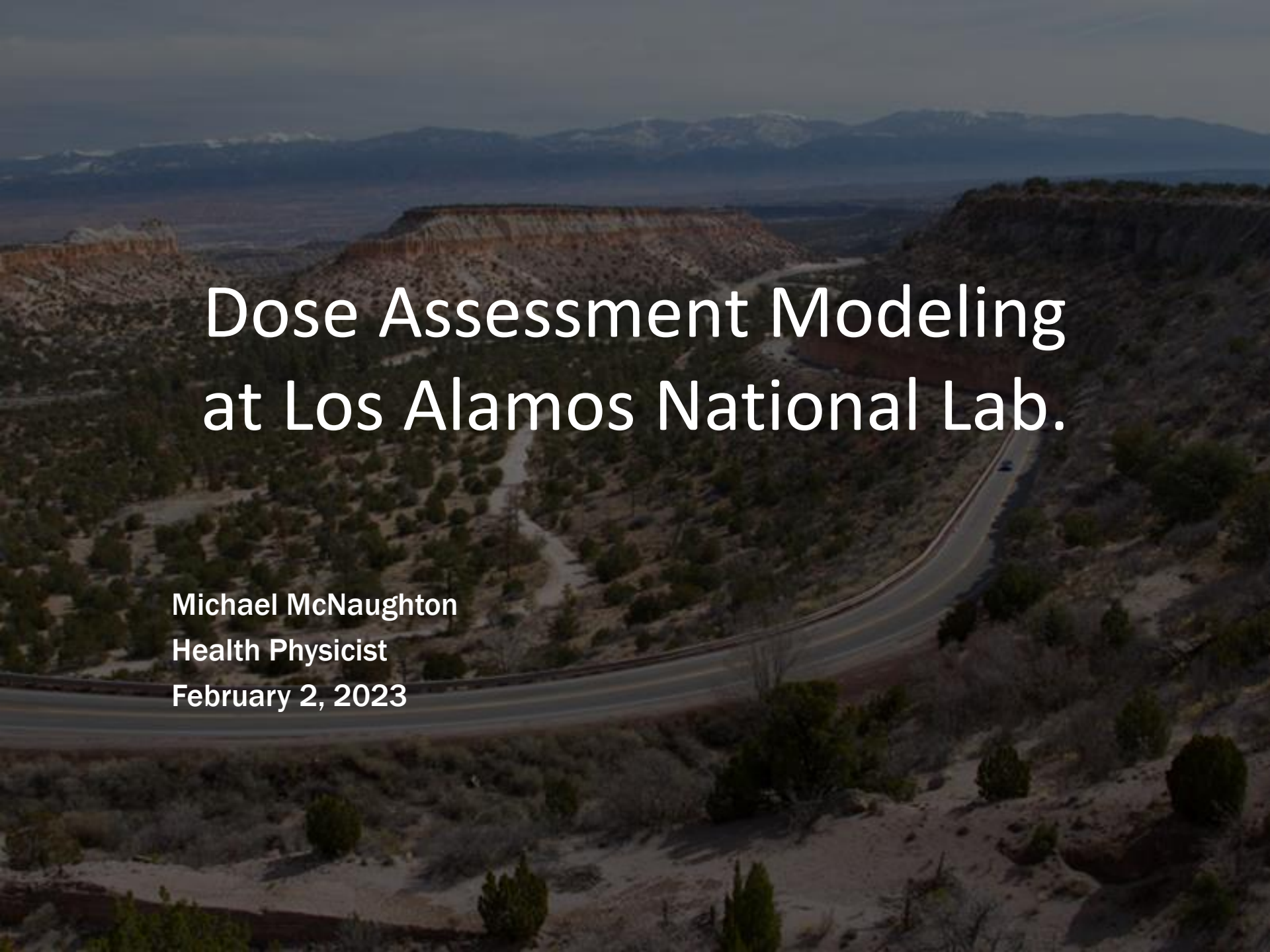
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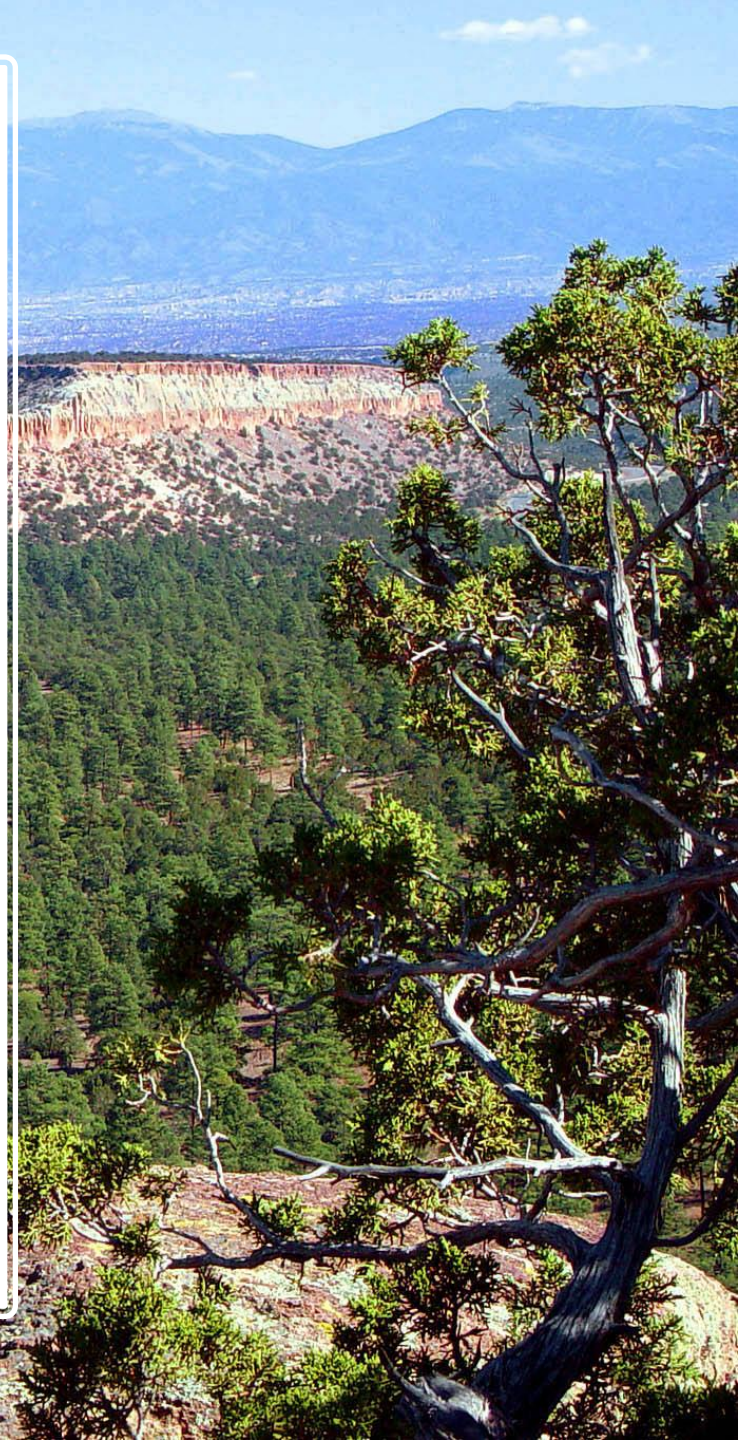
An aerial photograph of a desert landscape. A paved road with a yellow center line curves through the terrain, which is covered with sparse, low-lying vegetation. In the background, there are several mountain ranges, some with patches of snow or light-colored rock. The sky is clear and blue.

Dose Assessment Modeling at Los Alamos National Lab.

Michael McNaughton
Health Physicist
February 2, 2023

Site Information

- Legacy contamination is significant.
- 1945 technical areas were mixed with the residential areas.
- 1945 effluent went directly to the adjacent canyons.
- Now: water is carefully managed as a precious resource.
- Now: most nuclear facilities are ~1 km south of the townsite.



1945 MEI ~500 mrem; 2021 MEI = 0.5 mrem

This photo, taken on December 4, 1946, depicts what is now the center of Los Alamos as it looked during Project Y years. Called Technical Area 1, it was the core of the original Laboratory. Fuller Lodge and the houses of Bathtub Row (upper right of photo) are the only principal buildings that still exist.

TA-1 was decontaminated and demolished in stages as Laboratory functions were moved to a more isolated location across Los Alamos Canyon. By 1966, Laboratory property at TA-1 had been given to Los Alamos County or sold to private interests.

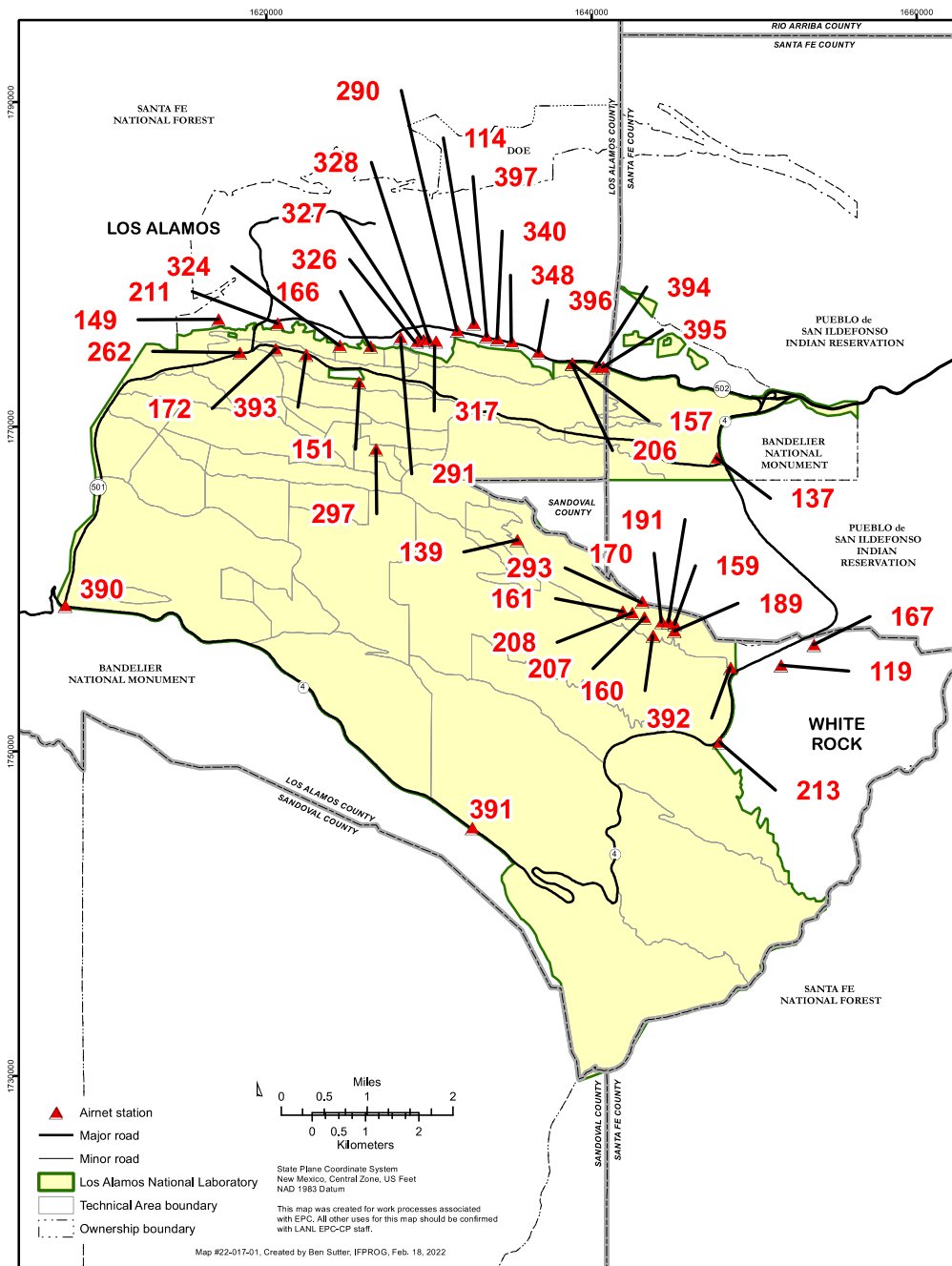


TECHNICAL BUILDINGS LAUR-07-4547

A Building — Administrative offices
 B Building — Mostly administrative offices
 Boiler House No. 2 — Supplied steam for TA-1
 C Building — Normal and uranium machine shops;
 (first building burned before May 1945)
 D Building — Plutonium and uranium chemistry and metallurgy
 D-2 Building — Laundry for contaminated clothing and glassware
 D-3 Building — Count room for H-1
 D-5 Building — Sigma vault. Used to store plutonium and uranium.
 E Building — Theoretical division labs and offices
 G Building — Housed the Sigma pile of graphite and uranium
 GAMMA — Labs and offices
 GAMMA 1 — Weapons components storage and assembly;
 (originally Ranch School ice house)
 H Building — Chemistry and plutonium research
 J Building — Radiochemistry; offices and laboratories
 K Building — Stockroom
 ML Building — Medical laboratory; radiation monitoring
 M Building — Processing and recovery of enriched uranium
 P Building — Personnel offices
 P-Prime Annex — Offices
 P-Prime Building — Supply and property offices
 Q Building — Medical and health monitoring
 R Building — Cryogenics, glass shop, model shop, and carpenter shop
 R-1 Building — Lumber rack
 R-2 Building — Lead storage
 S Building — General stock warehouse
 S-1 Building — Storage
 SIGMA — Uranium processing
 T Building — T-Division offices
 THETA — Warehouse
 U Building — Electronics
 V Building — Shops
 W Building — Van de Graaff accelerator
 X Building — Cyclotron
 Y Building — Physics Laboratory
 Z Building — Cockcroft-Walton machine

Site Information

- Accelerator facility emits ^{11}C , ^{13}N , ^{15}O .
- Isotope production facility emits activation products.
- Tritium facility is >5 km from residential areas.
- Plutonium and uranium emissions are small.



Air Sampling

- 20 air-sampling stations are along the southern edge of the townsite.
- The MEI locations are near these stations.
- 8 air-monitoring stations are near the Pueblo de San Ildefonso Indian Reservation.

Requirements or Guidance

At LANL, we often refer to the following.

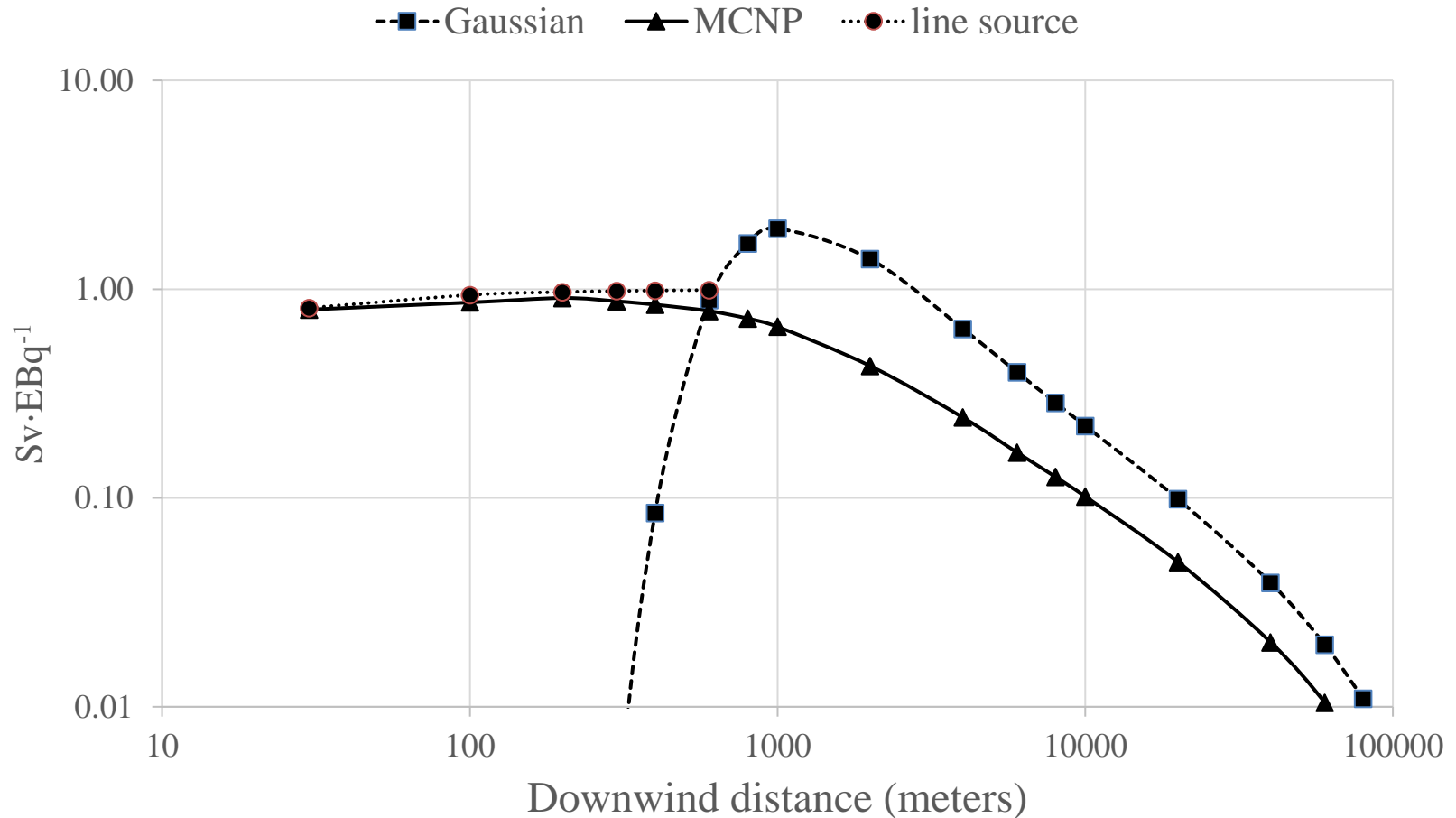
- DOE Order 458.1
- 40 CFR 61 Subpart H (Air)
- 40 CFR 141 (Water)
- DOE-STD-1196-2021 (Dose Conversion Factors)
- EPA Exposure Factors Handbook

Radiation Modeling

- **CAP88** is used for point sources and diffuse sources.
- 40 CFR 61 App. E is used for ambient air at the receptors.
- Direct radiation is measured near the source and near the receptor. **MCNP** calculates the dose.
- **MCNP** also calculates neutron energy spectra.
- **RESRAD** and hand calculations are used for ingestion.
- If <0.1 mrem/y, we use simple and conservative methods.
- We use annual sampling data for input. In 2022, there were ~1 million new database records.
- **CAP88** is not accurate for external radiation from airborne radioactive material, as shown in the following slides.

CAP88 uses a Gaussian plume model for external radiation.
It usually underestimates near the source and overestimates far from the source.

Three models for ^{135}Xe ; plume height = 20 meters; stability class F



Maximally Exposed Individual

- We calculate the dose at >30 locations; the largest is the MEI.

Major pathways are as follows.

- Inhalation dose is calculated by CAP88.
- Inhalation dose is also measured by ambient air samplers.
- External radiation from airborne material is calculated by CAP88.
- Direct radiation is measured near the source and calculated by MCNP.
- Other pathways contribute <0.1 mrem/year.
- radionuclides in food and drinking water are indistinguishable from background.

Site Specific Background

- Criterion: “Indistinguishable From Background”.
- → It is important to define the background!
- Soil background depends on geology.
- Building material background depends on its origin.
- Global fallout depends on rainfall, snowfall, and surface runoff.
- Wildfires increase surface concentrations.
- Vegetation-to-soil concentration ratios are variable.
- → It is challenging to define the background!

Thank you for listening.



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